Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A semiconductor device operable in THz spectral range, the device comprising a heterostructure including at least first and second semiconductor layers, the first and second layers being made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer, and providing an overlap between the valence band of the second layer and the conduction band of the first layer, a layout of the layers of the heterostructure being selected so as to provide a predetermined dispersion of energy subbands in the conduction band of the first layer and in the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands, whereby an application of an external bias field across the first and second layers causes the THz spectral range radiation originating from radiative transitions of non-equilibrium carriers between at least one of the following: neighboring energy subbands of the EQW, neighboring energy subbands of the HQW, and ground energy subbands of the EQW and HQW.

2. (Original) The device of Claim 1, wherein the first layer material is InAs-based and the second layer material is GaSb-based.

3. (Original) The device of Claim 2, wherein the thickness of each of the first and second layers is in a range of about 1-500nm.

4. (Original) The device of Claim 1, wherein the first and second layers are directly coupled to each other with no additional layer between them.

5. (Original) The device of Claim 1, wherein the heterostructure comprises a barrier layer between the first and second layers.

6. (Original) The device of Claim 5, wherein the barrier layer is based on AlSb.

7. (Original) The device of Claim 5, wherein the barrier layer has a thickness in a range of about 0.6-6 nm.

8. (Original) The device of Claim 1, wherein the heterostructure comprises first and second cladding layers enclosing the first and second layers therebetween, respectively.

9. (Original) The device of Claim 8, wherein the first and second cladding layers is selected from AlInAs-based and AlSb-based materials, respectively.

10. (Original) The device of Claim 5, wherein the heterostructure comprises first and second cladding layers enclosing therebetween the first and second layers with the barrier layer between the first and second layers.

11. (Original) The device of Claim 1, comprising an electrode arrangement providing electrical contacts to the first and second layers and thus enabling the application of said external bias field.

12. (Original) The device of Claim 1, configured as a resonator cavity, said heterostructure being operable as an active medium of the cavity.

13. (Original) The device of Claim 1, wherein said predetermined dispersion of the energy subbands is characterized by a predetermined energy gap of a THz spectral range between the ground energy subbands in the EQW and HQW.

14. (Original) The device of Claim 13, wherein said predetermined dispersion of the energy subbands is such that energy of the ground hole subband of the HQW without any coupling is higher than the energy of the ground electron subband of the EQW without any coupling.

15. (Original) The device of Claim 13, wherein said predetermined dispersion of the energy subbands is such that the

energy of the ground hole subband of the HQW without any coupling is lower than the energy of the ground electron subband of the EQW without any coupling.

16. (Original) The device of Claim 13, wherein said predetermined dispersion of the energy subbands is controlled by altering at least one of the following parameters: thickness of at least one of the layers, chemical compound of the material of at least one of the layers, width and predetermined potential profile of at least one of the quantum wells.

17. (Original) The device of Claim 16, wherein the parameters controlling the predetermined dispersion of the energy subbands include the thickness and chemical compound of the material of a barrier layer arranged between the first and second layers.

18. (Original) The device of Claim 16, wherein the parameters controlling the predetermined dispersion of the energy subband include the thickness and chemical compound of the material of cladding layers enclosing the first and second layers therebetween.

19. (Original) The device of Claim 16, wherein a material composition of at least one of the first and second layers is spatially inhomogeneous in a direction normal to the

respective layer, thereby providing the predetermined potential profile of the respective quantum well.

20. (Original) The device of Claim 1, wherein said THz radiation is enhanced by a resonance condition of the radiative transitions between at least one of following: the different neighboring subbands within the EQW, the different neighboring subbands within the HQW, and the different neighboring subbands of the EQW and HQW.

21. (Original) The device of Claim 20, wherein said resonance condition is further enhanced by the radiative transitions between the ground subband of the EQW and the ground subband of the HQW.

22. (Original) The device of Claim 20, wherein the neighboring energy subbands in at least one of the quantum well selected from the EQW and HQW are substantially equidistant, thereby causing said resonance condition of the radiative transitions between the neighboring energy subbands of the respective quantum well.

23. (Original) The device of Claim 20, wherein the neighboring energy subbands of the EQW and HQW are all substantially equidistant within each quantum well and a distance between the ground energy subbands of the EQW and HQW

is equal to the distance between the neighboring energy subbands of the EQW and HQW.

24. (Original) The device of Claim 19, wherein the predetermined potential profile of at least one quantum well selected from the EQW and HQW is substantially semi-parabolic, thereby providing substantially equidistance in between a plurality of the neighboring energy subbands in the respective quantum well for causing a resonance condition of the radiative transitions between the subbands.

25. (Original) The device of Claim 19, wherein the predetermined potential profile of at least one quantum well selected from the EQW and HQW is substantially step-like, while a few of the neighboring energy subbands in the respective quantum well are substantially equidistant for causing a resonance condition of the radiative transitions between the subbands.

26. (Original) The device of Claim 19, wherein the predetermined potential profiles of the EQW and HWQ include substantially semi-parabolic and step-like profiles.

27. (Original) The device of Claim 19, wherein the dispersion of the energy subbands is such that excited subbands

of the EQW define a nearly parabolic band-structure, and the ground subbands of the EQW and HQW define a W-like dispersion.

28. (Original) The device of Claim 22, wherein gain provided by the resonance condition is a certain times higher than a gain in the non resonant condition, said certain number of times being equal to the number of said resonant neighboring subbands.

29. (Original) The device of Claim 20, wherein said resonance condition is achieved for said neighboring subbands of the EQW within the entire certain range of variation of a wave-vector.

30. (Original) The device of Claim 29, wherein a majority of said neighboring subbands of the EQW are parallel in a subband dispersion plot.

31. (Original) The device of Claim 29, wherein the resonance condition is further enhanced by the radiative transition between the ground subband of the EQW and the ground subband of the HQW.

32. (Original) The device of Claim 31, wherein the radiative transition between the ground subband of the EQW and the ground subband of the HQW occurs when the wave-vector equals zero.

33. (Original) The device of Claim 29, wherein the resonance condition is further enhanced by the radiative transition between at least one of the following: (i) the ground subband of the EQW and the ground subband of the HQW at a certain non-zero magnitude of the in plane wave-vector and (ii) the ground subband of the HQW and its neighboring hole subband at a certain non-zero magnitude of the in plane wave-vector providing that an energy gap corresponding to these transitions is minimal.

34. (Original) A semiconductor device operable in THz spectral range, the device comprising a heterostructure including at least first and second semiconductor layers and al electrodes' arrangement providing electrical contacts to the first and second layers to apply a bias field across them, wherein

- the first and second layers are made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer, and providing an overlap between the valence band of the material of the second layer and the conduction band of the material of the first layer,
- a layout of the layers of the heterostructure and potential profiles of the EQW and HQW are selected so as to provide

a predetermined dispersion of energy subbands in the conduction band of the first layer and in the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands, said predetermined dispersion resulting in that the application of the external bias field across the first and second layers causes the THz spectral range radiation originating from a resonance condition of radiative transitions of non-equilibrium carriers between the neighboring energy subbands of the EQW, the neighboring energy subbands of the HQW, and the ground energy subbands of the EQW and HQW.

35. (Currently Amended) A method of fabricating a the semiconductor device of Claim 1 operable in a THz spectral range, the method comprising forming a heterostructure from selected layers

wherein the layers include at least first and second semiconductor layers made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer and providing an overlap between the valence band of the material of the second layer and the conduction band of the material of the first layer,

a layout of the layers of the heterostructure is selected so as to provide a predetermined dispersion of energy subbands in the conduction band of the first layer and the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands,

thereby enabling generation of THz radiation originating from radiative transitions of non-equilibrium carriers between at least one of the following: neighboring energy subbands of the EQW, neighboring energy subbands of the HQW, and ground energy subbands of the EQW and HQW.

36. (Original) The method of Claim 35, wherein said predetermined dispersion of the energy subbands is such that energy of the ground hole subband of the HQW without any coupling is higher than the energy of the ground electron subband of the EQW without any coupling.

37. (Original) The method of Claim 35, wherein said predetermined dispersion of the energy subbands is such that the energy of the ground hole subband of the HQW without any coupling is lower than the energy of the ground electron subband of the EQW without any coupling.

38. (Original) The method of Claim 35, wherein said predetermined dispersion of the energy subbands is provided by

altering at least one of the following parameters: thickness of at least one of the layers, chemical compound of the material of at least one of the layers, width and predetermined potential profile of at least one of the quantum wells.

39. (Original) The method of Claim 38, wherein the parameters controlling the predetermined dispersion of the energy subbands include the thickness and chemical compound of the material of a barrier layer arranged between the first and second layers.

40. (Original) The method of Claim 38, wherein the parameters controlling the predetermined dispersion of the energy subband include the thickness and chemical compound of the material of cladding layers enclosing the first and second layers therebetween.

41. (Original) The method of Claim 38, comprising selecting a material composition of at least one of the first and second layers to be with spatially inhomogeneous in a direction normal to the respective layer, thereby providing the predetermined potential profile of the respective quantum well.

42. (Original) The method of Claim 35, comprising selecting the layers' layout so as to enable creation of a resonance condition of the radiative transitions between at

least one of the following: the different neighboring subbands within the EQW, the different neighboring subbands within the HQW, and the different neighboring subbands of the HQW and EQW, thereby enhancing the THz radiation.

43. (Original) The method of Claim 42, wherein said resonance condition is further enhanced by the radiative transitions between the ground subband of the EQW and the ground subband of the HQW.

44. (Original) The method of Claim 42, wherein the layers' layout is selected such that a plurality of the neighboring energy subbands in at least one of the quantum well selected from the EQW and HQW are substantially equidistant, thereby causing said resonance condition of the radiative transitions between the neighboring energy subbands of the respective quantum well.

45. (Original) The method of Claim 42, wherein the layers' layout is selected such that the neighboring energy subbands of the EQW and HQW are all substantially equidistant within each quantum well and a distance between the ground energy subbands of the EQW and HQW is equal to the distance between the neighboring energy subbands of the EQW and HQW.

46. (Original) The method of Claim 41, wherein the predetermined potential profile of at least one quantum well selected from the EQW and HQW is substantially semi-parabolic, thereby providing substantially equidistance in between a plurality of the neighboring energy subbands in the respective quantum well for causing a resonance condition of the radiative transitions between the subbands.

47. (Original) The method of Claim 41, wherein the predetermined potential profile of at least one quantum well selected from the EQW and HQW is substantially step-like, while a plurality of the neighboring energy subbands in the respective quantum well are substantially equidistant for causing a resonance condition of the radiative transitions between the subbands.

48. (Original) The device of Claim 41, wherein the predetermined potential profiles of the EQW and HWQ include substantially semi-parabolic and step-like profiles.

49. (Original) The method of Claim 42, wherein gain provided by the resonance condition is a certain times higher than a gain in the non resonant condition, said certain number of times being equal to the number of the resonant neighboring subbands.

50. (Original) The method of Claim 42, wherein said resonance condition is achieved for said neighboring subbands of the EQW within the entire range of variation of a wave-vector.

51. (Original) The method of Claim 50, wherein said neighboring subbands of the EQW are parallel in a subband dispersion plot.

52. (Original) The method of Claim 50, wherein said resonance condition is further enhanced by the radiative transition between the ground subband of the EQW and the ground subband of the HQW.

53. (Original) The method of Claim 50, wherein the radiative transition occurs when the wave-vector equals zero.

54. (Original) The method of Claim 50, wherein said resonance condition is further enhanced by the radiative transition between the ground subband of the HQW and its neighboring subband at a predetermined magnitude of the wave-vector to provide that an energy gap between the ground subband of the HQW and its neighboring subband is minimal.

55. (Currently Amended) A method of fabricating ~~a~~ the semiconductor device of Claim 1 operable in a THz spectral range, the method comprising forming a heterostructure from selected layers

wherein the layers include at least first and second semiconductor layers made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer and providing an overlap between the valence band of the second layer and the conduction band of the first layer,

a layout of the layers of the heterostructure is selected so as to provide a predetermined dispersion of energy subbands in the conduction band of the first layer and the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands, the predetermined dispersion being such that application of a bias field across the first and second layers results in generation of THz radiation originating from a resonance condition of radiative transitions of non-equilibrium carriers between the neighboring energy subbands of the EQW, the neighboring energy subbands of the HQW, and the ground energy subbands of the EQW and HQW.

56. (Currently Amended) The method of fabricating ~~a~~ the semiconductor device of Claim 1 operable in a THz spectral range, the method providing for improved temperature characteristics of the device and comprising forming a heterostructure from selected layers

wherein the layers include at least first and second semiconductor layers made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer and providing an overlap between the valence band of the second layer and the conduction band of the first layer,

a layout of the layers of the heterostructure is selected so as to provide a predetermined dispersion of energy subbands in the conduction band of the first layer and the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands, the predetermined dispersion being such that application of a bias field across the first and second layers results in generation of THz radiation originating from a resonance condition of radiative transitions of non-equilibrium carriers between the substantially parallel and equidistant neighboring energy subbands of the EQW, the neighboring energy subbands of the HQW, and the ground energy subbands of the EQW and HQW.

57. (Currently Amended) The method of fabricating ~~a~~ <u>the</u> semiconductor device <u>of claim 1</u> operable in a THz spectral range, the method providing for improved radiative characteristics of the device and comprising forming a heterostructure from selected layers

wherein the layers include at least first and second semiconductor layers made of materials providing a quantum mechanical coupling between an electron quantum well (EQW) in the first layer and a hole quantum well (HQW) in the second layer and providing an overlap between the valence band of the second layer and the conduction band of the first layer,

a layout of the layers of the heterostructure is selected so as to provide a predetermined dispersion of energy subbands in the conduction band of the first layer and the valence band of the second layer to define a desired effective overlap between the energy subbands of said conduction and valence bands, the predetermined dispersion being such that application of a bias field across the first and second layers results in generation of THz radiation originating from a resonance condition of radiative transitions of non-equilibrium carriers between the substantially parallel and equidistant neighboring energy subbands of the EQW, the neighboring energy subbands of the HQW, and the ground energy subbands of the EQW and HQW.

58. (Original) The method of Claim 56, providing for suppressing Auger recombination as a result of effective screening of Coulomb interaction.

59. (Original) The system of Claim 56, providing for suppressing optical phonon scattering for a radiated frequency lower than that of optical phonons.